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AGRICULTURAL MEMORANDUM NO 440

THE MULTI-SPAN GLASSHOUSE; HAND CALCULATIONS OF PERCENTAGE TRANSMISSION

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1. INTRODUCTION

A procedure for estimating the solar radiation that falls on the floor of a multi-span house is set down in Ag Mem 328.

Since it now seems unlikely that the procedure will be programmed for a computer, the purpose of this note is simply to give the results that were obtained for a few simple cases by hand calculation (whilst the possibility of programming was being explored).

The obvious comparison must be with the results obtained for the single-span house. Though the same basic approach was followed for the multi-span as the single span house, namely the summation of the contribution to the radiation received at the floor of the house from each wall and roof surface, there were important differences in detail the later work. The Angle Factor, the proportion of radiation emitted by one surface and intercepted by another, was now treated quite rigorously; in addition, the reflection of radiation, both direct and diffuse, between the surfaces of the house was incorporated into the calculations.

2. CURRENT DATA

The results obtained for the 2 types of single-span house (timber vinery, alloy wide-span) have been reported in detail elsewhere, by Kingham and Smith (1971). For convenience, certain of these results are reproduced below for direct comparison with those obtained by hand calculation. The house used for the calculations now reported was a standard "Frampton-Ferguson" of 3 spans. The dimensions were length = 59.16m
width = 3 span each of 9.25m
height to ridge = 4.95m
roof angle = 27°
free area (proportion freely transmitting)
roof = 0.80
sidewall = 0.84
end wall = 0.80

3. RESULTS

PERCENTAGE TRANSMISSION OF THE THREE TYPES OF GLASSHOUSE

JANUARY

ORIENTATION E-W	Timber Vinery	Alloy Wide-span	Frampton Ferguson (3 span)
Direct radiation	52.5	65.7	71.0
Diffuse radiation	56.0	71.7	58.0
Total radiation	54.9	69.8	62.0

ORIENTATION N-S	Timber Vinery	Alloy Wide-span	Frampton Ferguson (3 span)
Direct radiation	39.3	49.7	48.0
Diffuse radiation	56.0	71.7	58.0
Total radiation	50.8	64.9	55.0
JUNE			
ORIENTATION E-W			
Direct radiation	52.6	59.0	61.0
Diffuse radiation	57.3	73.4	58.0
Total radiation	55.0	66.4	60.0
ORIENTATION N-S			
Direct radiation	59.5	65.8	60.0
Diffuse radiation	57.3	73.4	58.0
Total radiation	58.3	69.8	60.0

4. COMMENTS

4.1 The overall result, for total radiation, is that the multi span house gives a percentage transmission intermediate between the heavily structured timber-vinery and the lighter, more open alloy wide-span (single span) house. This result seems reasonable and at least indicates that multi-span calculations, untried until now, produce figures of the right kind of order.

4.2 Despite a reduction in the house width to house length ratio given by working with a multi span house, the results for January indicate a marked dependence still an orientation for the radiation within the house; this follows once again from the dependence on orientation of the angle of incidence of direct radiation onto the roof surfaces.

4.3 It is not suggested that any great weight should be given to the relative figures shown for alloy wide-span and multi span house, for direct radiation in the E-W orientation. If one recalls that the multispan calculations include an element for reflection and that this was omitted from the single-span calculations, then the apparent advantage of the multispan structure is removed.

4.4 A percentage transmission for diffuse radiation for the multispan house only a little better than for the timber vinery house is perhaps a little surprising. Here the angle factor calculations are critical and the more recent work gives the more rigorous treatment. The conclusion to be drawn perhaps, is that the partitioning of the radiation in the single span house should be shifted a little in favour of the direct radiation, with consequent further emphasis on the effects of orientation in that situation.

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REFERENCES

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